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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the application of:

Akira NISHIMURA et al.

Serial No.: 09/079,468

Filing Date: May 15, 1998

For: CLOTH PREPREG AND WET
PROCESS FOR MANUFACTURING
THE SAME

Examiner: Unassigned

Group Art Unit: 1771

TC 1700 MAIL ROOM

RECEIVED

MAY 16 2000

DECLARATION OF AKIRA NISHIMURAAssistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Akira Nishimura declares under penalty of perjury under the laws of the United States of America as follows:

1. I am a national of Japan, residing at 1455, Oaza Tsutsui, Masaki-cho, Iyo-gun, Ehime 791-3120, Japan. I am a co-applicant of the invention as described and claimed in the specification of the above-identified application. I have reviewed the Office Action dated December 13, 1999. I received a bachelor's degree in Engineering in 1964 from University of Kanazawa. After graduation, I joined employment at Toray Industries, Inc (Toray). Then until 1971, I have been at Toray as a researcher in Synthetic Fiber Weaving. Since 1972, I have been involved in the development of carbon fiber woven fabrics as a pioneer in the field. I received technical awards on the development of carbon fiber fabrics from the Japan Society for

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00年05月12日(金)10時53分 織:織部

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R:900

P.03/05

Composite Materials in 1991 and 1998. I am now a Chief Research Engineer in the Composite Materials Research Laboratories of Toray.

2. I present this Declaration to explain the differences between a prepeg from the woven fabric of Homma '107 and a prepeg of this invention. In the following description, "Example" is an example within the scope of the present invention and "Comparative example" is an example using the fabric disclosed in USP'107 was used.

3. Table 1 shows the properties of the woven fabrics of Homma '107 and this invention.

Table 1

	Example	Comparative Example
Reinforcing fiber	Carbon fiber: "TORAYCA" T700SC-12K-60E	
Number of filament of reinforcing yarn	12,000	
Woven density(y/cm): Warp Weft	1.21 1.21	
Number of crossing points (picces/m ²)	14,400	
Woven construction	Plain	
Cover factor of woven fabric (%)	100	
Low melting point binder polymer	Copolyamide yarn, mp:120°C	
Binder position	Warp and weft	
Binder quantity (g/m ²)	2.0	

4. The low melting binder polymer used in the woven fabric of this invention was 100 denier and 50 denier copolyamide yarn "Elder" in the warp and weft directions, respectively, as shown in Fig. 2 of the present application. The woven fabric was heated on the weaving machine to melt the "Elder" yarn so that the carbon fibers of the fabric were adhered with each other with the "Elder" yarn. The copolyamide yarn "Elder" is a hot melt binder yarn commercially sold by Toray and is insoluble in methyl ethyl ketone (MEK).

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P.04/05

5. A typical wet process, as that described in paragraph 6, was used for manufacturing a prepreg from the woven fabric of Homma '107 and a prepreg of this invention.

6. A diluted resin was prepared with 100 wt parts of 130°C curable type #2500 epoxy resin, which is a popular epoxy resin for carbon fiber reinforced plastics (CFRP) commercially sold by Toray, and 125 wt parts of MEK so that a prepreg resin weight ratio WR becomes about 45%. 1000 ml of the diluted resin was placed in a vat having 350 mm length, 250 mm width and 50 mm depth and the fabric was dipped in the diluted resin completely and kept for 2 minutes to be sufficiently impregnated with the resin. The impregnated fabric was drawn out and dried by blowing hot air onto the surface of the fabric with the heating gun #881 of Hakko Co. Ltd. (1 kw, air velocity: 360 m/min, blowing air quantity: 0.2 m³/min). The distance between the heating gun and the fabric was kept at about 200 mm and the temperature at the fabric surface was kept at about 120°C for 15 minutes by adjusting the temperature on the temperature dial. While blow drying, the fabric was oscillated along the horizontal direction to uniformly heat the fabric.

7. "Cover factor" was determined by the following equation.

$$\text{Cover factor} = \frac{[(L_{warp} - W_{warp}) \times (L_{weft} - W_{weft})]}{(L_{warp} \times L_{weft})} \times 100$$

wherein, L_{warp} and L_{weft} are intervals of warps and wefts, respectively; W_{warp} and W_{weft} are yarn widths of warp and weft, respectively; and each of L_{warp} , L_{weft} , W_{warp} and W_{weft} are average value of 10 measurements by vernier calipers.

8. The properties of the prepreg from the woven fabric of Homma '107 and the prepreg of this invention are shown in Table 2. In particular, Table 2 shows that the prepreg from the woven fabric of Homma '107 has a cover factor of 75% while the prepreg of this invention has a cover factor of 97%.

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R:900

P.05/05

Table 2

Linear binder	Example				Comparative example			
	"Elder" yarn				None			
Fabric or prepreg	Fabric		Prepreg		Fabric		Prepreg	
	Warp	Weft	Warp	Weft	Warp	Weft	Warp	Weft
Yarn interval (mm)	8.3	8.5	8.4	8.3	8.3	8.3	8.4	8.3
Yarn width (mm)	7.1	8.5	6.6	7.1	6.9	8.3	3.9	4.4
Cover factor (%)	100		97		100		75	

9. The fabric and the prepreg of the Example are shown in Photograph 1 and the fabric and the prepreg of the Comparative example are shown in Photograph 2. Comparing the prepregs of the Example and Comparative example, it is clear that the prepreg of the Example has much less "openings" than the prepreg of the Comparative example. It was also observed during the heating of the impregnated fabric that bubbles were formed as the solvent was evaporated. These bubbles caused the openings in the Comparative example to be wide while the openings in the Example were not so wide.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct. Executed at Masaki-cho, Iyo-gun, Ehime, Japan, this 12th day of

May, 2000.

Akira Nishimura

Akira Nishimura

Photograph2. Comparative example

